We Claim:

1. A process comprising
   (a) providing a substantially inorganic photoreactive composition;
   (b) exposing, using a multibeam interference technique involving at least three beams, at least a portion of said photoreactive composition to radiation of appropriate wavelength, spatial distribution, and intensity to produce a two-dimensional or three-dimensional periodic pattern of reacted and non-reacted portions of said photoreactive composition; and
   (c) removing said reacted portion or said non-reacted portion of said photoreactive composition to form interstitial void space.

2. The process of Claim 1 wherein said periodic pattern is three-dimensional.

3. The process of Claim 1 wherein said periodic pattern has submicron-scale periodicity.

4. The process of Claim 1 wherein said substantially inorganic photoreactive composition comprises (a) at least one reactive species; (b) a photoinitiator system; and (c) optionally, a plurality of inorganic particles.

5. The process of Claim 4 wherein said substantially inorganic photoreactive composition loses less than about 60 percent of its initial weight upon photoreaction and pyrolysis.

6. The process of Claim 4 wherein said reactive species is a curable species.

7. The process of Claim 6 wherein said curable species is organic or hybrid organic/inorganic.

8. The process of Claim 4 wherein said substantially inorganic photoreactive composition comprises at least one material selected from the group consisting of condensates of photoreactive silanes, condensates of mixtures of reactive and non-reactive silanes, oligomeric siloxane materials, branched silicon-containing oligomeric and polymeric materials, and sol-gel materials.

9. The process of Claim 4 wherein said photoinitiator system comprises (a) at least one multi-photon photosensitizer; (b) at least one electron acceptor; and (c) optionally, at least one electron donor.

10. The process of Claim 9 wherein said photoinitiator system comprises at least one electron donor.

11. The process of Claim 9 wherein said multi-photon photosensitizer has a two-photon absorption cross-section greater than that of fluorescein.

12. The process of Claim 9 wherein said multi-photon photosensitizer has a two-photon absorption cross-section greater than about 1.5 times that of fluorescein.

13. The process of Claim 9 wherein said multi-photon photosensitizer is selected from Rhodamine B, molecules in which two donors are connected to a conjugated π (pi)-electron bridge, molecules in which two donors are connected to a conjugated π (pi)-electron bridge which is substituted with one or more electron accepting groups, molecules in which two acceptors are connected to a conjugated π (pi)-electron bridge, and molecules in which two acceptors are connected to a conjugated π (pi)-electron bridge which is substituted with one or more electron donating groups.

14. The process of Claim 13 wherein said multi-photon photosensitizer is Rhodamine B.

15. The process of Claim 9 wherein said electron acceptor is selected from the group consisting of iodonium salts, chloromethylated triazines, diazonium salts, sulfonium salts, azinium salts, triarylimidazolyl dimers, and mixtures thereof.

16. The process of Claim 10 wherein said electron donor is selected from the group consisting of amines; amides; ethers; ureas; sulfinic acids and their salts; salts of ferrocyanide, ascorbic acid and its salts; dithiocarbamic acid and its salts; salts of xanthates; salts of ethylene diamine tetraacetic acid; salts of $(alkyl)_n(aryl)_m$borates, wherein $n + m = 4$; SnR_4 compounds, wherein each R is independently selected from alkyl, aralkyl, aryl, and alkaryl groups; ferrocene; and mixtures thereof.

17. The process of Claim 4 wherein said inorganic particles are selected from the group consisting of metal oxide particles, metal carbonate particles, metal fluoride particles, and combinations thereof.

18. The process of Claim 17 wherein said inorganic particles are metal oxide particles.

19. The process of Claim 18 wherein said metal oxide is selected from the group consisting of silica, titania, alumina, zirconia, vanadia, antimony oxide, tin oxide, and mixtures thereof.

20. The process of Claim 19 wherein said metal oxide is silica.

21. The process of Claim 4 wherein said inorganic particles are less than about 150 nanometers in average diameter.

22. The process of Claim 4 wherein said inorganic particles have been surface treated.

23. The process of Claim 1 wherein said exposing is carried out using a multibeam interference technique involving at least four beams.

24. The process of Claim 1 wherein said exposing is by irradiating in pulsed mode.

25. The process of Claim 1 wherein said radiation is near-infrared radiation.

26. The process of Claim 1 wherein said non-reacted portion of said photoreactive composition is removed to form said interstitial void space.

27. The process of Claim 26 wherein said removing of said non-reacted portion of said photoreactive composition is accomplished by development with a solvent.

28. The process of Claim 26 wherein said process further comprises the step of at least partially filling said interstitial void space with at least one material having a refractive index that is different from the refractive index of said reacted portion of said photoreactive composition.

29. The process of Claim 28 wherein said filling involves deposition of said material by chemical vapor deposition.

30. The process of Claim 28 wherein said process further comprises the step of removing said reacted portion of said photoreactive composition.

31. The process of Claim 30 wherein said removing is by chemical etching.

32. The process of Claim 28 wherein said material has a refractive index greater than about 2.

33. The process of Claim 28 wherein said material is an inorganic semiconductor.

34. The process of Claim 33 wherein said inorganic semiconductor is selected from the group consisting of silicon, germanium, selenium, gallium arsenide, indium phosphide, gallium indium phosphide, and gallium indium arsenide.

35. The process of Claim 34 wherein said inorganic semiconductor is silicon.

36. The process of Claim 1 wherein said process further comprises the step of exposing at least a portion of said non-reacted portion of said photoreactive composition to radiation of appropriate wavelength and intensity to cause multiphoton absorption and photoreaction to form additional reacted portion and a remaining non-reacted portion.

37. The process of Claim 1 wherein said process further comprises sintering, pyrolysis, and/or annealing.

38. A process comprising

(a) providing a substantially inorganic photoreactive composition comprising

(1) at least one cationically reactive species,

(2) a multiphoton photoinitiator system, and

(3) optionally, a plurality of surface-treated silica particles;

(b) exposing, using a multibeam interference technique involving at least four beams, at least a portion of said photoreactive composition to radiation of appropriate wavelength, spatial distribution, and intensity to produce a three-dimensional, submicron-scale, periodic pattern of reacted and non-reacted portions of said photoreactive composition; and

(c) removing said non-reacted portion of said photoreactive composition to form interstitial void space.